Farnell

C2

POWER SUPPLY UNIT

INSTRUCTION BOOK

FARNELL INSTRUMENTS LIMITED

INSTRUCTION

MANUAL

FOR

C2

POWER SUPPLY UNIT

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SECTION 1

INTRODUCTION

The instrument, type C2, covered in this manual, is a bench power supply designed to provide constant voltage or constant current, both modes being completely variable from zero to maximum by coarse and fine controls on the front panel. Mode indication is by means of lamps and change over from one mode to the other is completely automatic.

The C2 gives a maximum voltage of 30 volts and a maximum current of 2 amps. Voltage and current being monitored independently by two seperate meters.

The semi-conductor complement of this supply is silicon throughout and all components are chosen and rated to give maximum reliability. The main control amplifiers are silicon integrated circuit operational amplifiers.

To ensure maximum cooling efficiency, the main regulators and heatsink are mounted externally at the rear of the unit.

The instrument will accept mains voltage from 110 - 120 and 210 - 240V A.C. selection being made by means of a selector on the back panel. Mains input is applied via a 3 pin plug and socket at the rear and D.C. output obtained from terminals on the front panel. Remote sensing terminals are also provided on the front panel and these should be linked to their appropriate output terminals when not required.

An output on-off switch is fitted which allows the load to be disconnected from the unit without switching off the supply.

Mains input and line fuses are fitted as a precaution against component failure.

SECTION 2

OPERATING INSTRUCTIONS

Ensure that the mains selector on the back of the unit is set to the correct position.

Connection to the mains supply is via the three pin plug and socket at the rear of the unit. The mains lead should be connected to a suitable three pin plug: RED wire to LINE: BLACK wire to NEUTRAL and GREEN wire to EARTH.

Front panel controls

Apart from the mains switch, output switch and output terminals, the front panel layout has been so arranged that the voltage controls and indicators are on the left and current controls and indicators are on the right.

Output terminals

These are the main D.C. output terminals: Red - Positive: Black - Negative.

Feedback terminals

These terminals are used for remote sensing of load voltage and are provided to correct for the voltage drop along the connecting leads when the supply is operated in the constant voltage mode. Wires should be connected from the remote end of the negative lead to the terminal marked FEEDBACK - and from the remote end of the positive lead to the FEEDBACK + terminal. When not required, output and appropriate feedback terminals should be connected together with the links provided.

Earth terminal

This terminal is connected directly to the chassis of the instrument and also to the earth pin on the mains input socket. The D.C. output of the unit is fully floating so that either the positive or negative output terminal may be strapped to earth if required.

Mains switch

This switch is situated at the lower left hand side of the instrument. When switched on, a warm-up period of about 30 minutes is recommended in order to allow the unit to reach thermal equilibrium.

Output switch

This switch is situated on the lower right hand side of the instrument and is used to connect or disconnect the supply from the load, thus eliminating the warm-up period when the supply is again required.

Volts adjust

Two controls are provided to adjust the output voltage, one coarse and the other fine. They are situated on the left of the front panel. The controls are side by side and the fine control is the one on the extreme left of the unit.

Voltage and current monitoring

Voltage and current are monitored by seperate meters.

Mode indication (constant voltage)

This is a green indicator lamp situated above the voltage adjust controls, on the left hand side of the front panel and when lit, indicates that the instrument is delivering constant voltage at the output terminals.

Current adjust

Two controls are provided to adjust the output current, one coarse and the other fine. They are situated on the right of the front panel. The controls are side by side and the fine control is on the extreme right of the unit.

Mode indication (constant current)

This is a red lamp situated above the current adjust controls on the right hand side of the front panel and when lit, indicates that the unit is delivering constant current to the load.

Operation in constant voltage

Switch on the unit and leave for a warm-up period of approximately 30 minutes. Short circuit the output terminals, switch on the output, and adjust the current controls until the meter reads the expected load current + 10%. This will safeguard the load circuit from excessive currents if a fault condition occurs. Open circuit the output terminals and set the required voltage using the coarse and fine voltage controls. Switch off the output and connect the load circuit to the output terminals. If remote voltage sensing is required remove the links from the feedback terminals and connect wires from them to the load circuit as described under the paragraph headed "Feedback Terminals". The setting of the maximum current capability of the unit to load current +10% is purely a precaution to safeguard the external circuit and could, of course, be adjusted to maximum if the operator requires to do so.

Operation in constant current

After warm-up, current may be set by connecting a short circuit across the output terminals.

Caution

Although the instrument changes from constant voltage to constant current modes automatically it must be borne in mind that, due to the requirements of the constant voltage mode, a capacitor is connected across the output terminals. The value of this capacitor is 32μF and has been chosen as a compomise between the conflicting requirements of constant voltage and constant current.

If the instrument is now set to give a constant current of say 10 m/A and the voltage is set at say 30 volts, a short circuit across the output terminals will cause a discharge current from the capacitor which is many times greater than the set current limit and is limited only by the resistance of the connecting wires. This discharge current is not limited by the control amplifier.

Therefore, provision has been made whereby on removal of the link between feedback - and output - terminals, a 1K resistor is inserted in series with the capacitor in order to limit the discharge current to 30 m/A or less, according to the set conditions. Because of this discharge current; which only occurs on sudden application of load or change in load conditions, it is obviously advisable to set the voltage limit as close as is practical to the actual working voltage and a figure of say 10% in excess would be considered reasonable. Once the capacitor has discharged, the instrument regulates the current to the preset figures, the response time of the amplifier being governed by the time constant of the load resistance times the output capacitor, plus of course, any load capacitance which may be present. Removal of the link is therefore purely a safety measure and need not be removed if the operator is satisfied that the load is capable of withstanding the initial surge current. Alternatively, the link need not be removed if the load is presented to the output terminals with the voltage controls set at minimum initially and then increased until the instrument changes from constant voltage to constant current mode.

SECTION 3

CIRCUIT DESCRIPTION

The circuit employs series regulator transistors driven by emitter followers from a voltage amplifier. This amplifier is driven by either a differential amplifier which compares a proportion of the output voltage to that of a reference voltage, or by a differential amplifier which compares the voltage drop (proportional to output current) across a resistor, with a reference voltage. Both amplifiers operate independently and the change over from voltage to current control is completely automatic.

The mains supply is connected to the transformer TR1 via the mains switch SW1, input fuse F1 and the voltage selector. The mains secondary winding is 0-35V which is rectified by the bridge consisting of diodes D1-4. The resultant unregulated D.C. is derived across reservoir capacitor C2 and C3. The resistor R1 is connected across the reservoir capacitor to act as a bleed on switch off. The positive line is connected to the positive output terminal via the series regulators VT10, VT11 and the sensing resistors R36 and R40. The negative line is connected to the negative output terminal via the output fuse F2, the meter monitoring resistor R33 and the output switch SW2.

The auxilliary supply is derived from the two 0-36V windings on the transformer which are connected to give 36-0-36V to the diodes D5 and D6, the resultant D.C. supply is derived across reservoir capacitors C4 and C5. This unregulated D.C. is in the order of 50V. This is dropped to 20V by the network R2, Z1 and Z2. The centre tap of Z1 and Z2 is taken to the positive output terminal via the feedback terminal and therefore the differential amplifiers are supplied from the zener stabilised rails which are polarized + 10V and - 10V with respect to the main positive output terminal.

The main reference voltage for the constant voltage amplifier is derived from the zener diode Z3 which is fed from the + 10V rail via the constant current feed circuit consisting of R4, R5, R6, VT1 and VT2. This provides a current of approximately 8 m/A which is divided in the ratio of 6.5 m/A to the reference zener and 1.5 m/A the potentiometer chain comprising of R8, R9, P1 and P2 to the negative output terminal.

Voltage mode

The voltage mode differential amplifier consists of the integrated circuit amplifier IC1 which is a long tailed pair amplifier with emitter follower output. The non inverting input is taken via R10 to the junction of P1 and R9 on the potentiometer chain.

The action of the circuit is as follows:-

If the voltage across the output terminals falls this change is impressed onto the inverting input IC1 via P1 and P2 which results in a negative going signal at its' output. This decrease in voltage is applied to the base of VT3 via the gating diode D9 thus tending to turn VT3 off and causing its collector voltage to rise. The increase in collector voltage is applied to the emitter followers VT's 8-11 turning them further on, thus increasing the output voltage and opposing the original output voltage fall.

The action of the voltage loop from above is to hold the two inputs of IC1 at equal potentials. It follows that the output voltage is determined by the ratio of the resistances of P1 and P2 to R8 + R9. Since the reference voltage from Z3 (approximately 5V positive) is applied to the end of the potentiometer chain and the inverting input of IC1 tends to seek zero, it follows that if P1 and P2 are set to equal R8 + R9, then the voltage at the negative terminal must be 5 volts to provide balance. If P1 + P2 = 6 (R8 + SOT1), then the output must be 30 volts in order to maintain a balance. R9 is in fact adjusted with P1 and P2 at maximum to give 30 volts across the output terminals. C9 is a speed up capacitor, which impresses A.C. variations at the output terminals directly on to the inverting input of IC1 which makes the amplifier more sensitive to sudden changes of voltage.

Current mode

The current mode amplifier consists of IC2. The reference voltage for current mode operation is derived from Z6 which is fed from the constant current circuit comprising of R27, 28, 29 and VT's 6 and 7. The feed current is approximately 8 m/A with 5 m/A passing through Z6, 1 m/A passing through the network R24, 25 and 26 and 2 m/A passing through R21, R22, P3 and P4. R36 in parallel with R40 acts as the current sensing resistor and is arranged to drop about 1.5 volts when maximum current is being drawn. Operation of amplifier is as follows:-

The setting of P3 and P4, the output current controls, provide a bias which is a proportion of Z6 voltage, to the inverting input of IC2. The non inverting input of IC2 is connected to output positive via R26 and R36 in parallel R40 and assuming no load, the non inverting input of IC2 will be negative to the inverting input due to the divider network R24, 25 and 26. The output from IC2 must therefore be negative which reverse biases the diode D10, the drive to the base of VT3 being taken from the voltage mode amplifier via D9. On increasing the load on the output the current through R36 in parallel with 40 increases and therefore the voltage on the non inverting input of IC2 begins to rise with respect to the output positive terminal. When this voltage approaches the tapped voltage from the reference the output from IC2 begins to move in a positive direction until it reaches the point where D10 becomes forward biased and the drive to VT3 base is taken from the current mode amplifier. With further decrease in load resistance, as the current cannot exceed the value determined by P3 and P4 settings the series regulator is gradually turned off and the output voltage falls. meanwhile, P1 and P2 are still set at the original voltage setting for the voltage amplifier. Therefore, as the output voltage falls the inverting input of IC1 is driven positive and results in a negative going signal at its output. This reverse biases the gating diode D9 and renders the voltage amplifier inoperative.

Lamp control circuit

When IC1 is operative in the voltage mode IC2 is inoperative. The output of IC1 to the base of VT4 is approximately 1.5V positive and the output of IC2 to the base of VT5 is below zero. Therefore, VT4 is driven on and the voltage mode indicator PL1 is illuminated. These bias conditions reverse when the unit is operated in the constant current mode thus causing VT5 to conduct and the indicator PL2 to illuminate.

Compensation network

Current control is achieved by sensing the voltage across R39. The current flowing through R36 in parallel with R40 is made up of load current, current for the voltmeter, and current from the voltage determining potentiometer chain P1, P2 R8 and R9. The voltmeter current, and potentiometer chain current (for a given output voltage setting) are proportional to output voltage. If the voltage controls are set to 30V output, the current drawn by the voltmeter and potentiometer chain at 30 volts output is 1.6 m/A, this reduces to zero as the load resistance is reduced to zero, whilst the current mode control maintains constant voltage across R36 in parallel with R40. This results in an increase in output current of 1.6 m/A as load resistance is decreased to zero.

The network R14, T1 and R23 compensates for the above effect, by feeding a signal approximately proportional to output voltage from the junction of R9 and P1 to the non inverting input of IC2. As this network would allow a current to be fed back in the reverse direction and degrade the voltage regulation when the unit is operated in the constant voltage mode, a further network consisting of R7 and R15 is inserted in order to cancel out this reverse current.

SECTION 4

SETTING UP PROCEDURE

Ensure that the mains voltage selector on the back panel is set to the correct position. Set all preset potentiometers fully anti-clockwise. Set all variable potentiometers fully clockwise. Link the feedback terminals to their appropriate output terminals. Solder a temporary link across the SOT2 turret tags.

Setting maximum output volts

Solder flying lead to a 2KΩ potentiometer and place in circuit in the SOT1 position. Switch on unit, connect a voltmeter across the output terminals and adjust the 2KΩ potentiometer until the unit provides an output of 30 volts. Measure the value of the potentiometer setting and select the nearest 5% metal film resistor below this value and solder in the SOT1 position.

Setting voltmeter F.S.D.

Adjust the unit by the front panel controls to provide 30 volts as read on the external voltmeter connected across the output terminals. Adjust T3 until the meter reads full scale.

Setting maximum output current

Apply external emitter in series with an adjustable lead to the output terminals. Remove the temporary link from the SOT2 turret tags and replace with a 2K potentiometer. Adjust the external load until the emitter reads 2.2 amps. Gradually increase the setting of the 2KΩ potentiometer until the current amplifier takes over. This will be indicated by a reduction in output current. Continue increasing the potentiometer until the output current reduces to 2 amps. Measure the value of the potentiometer and select the nearest 5% metal film resistor below this value and solder in the SOT2 position.

Setting ammeter F.S.D.

Adjust the unit by the front panel controls to provide 2 amps as monitored on the external meter. Adjust T2 until the meter reads full scale.

Setting compensation network

Connect a 4.7KΩ resistor in series with a 5Ω resistor across the output terminals. Set volts to maximum and adjust current controls to provide a constant current of 10 m/A. In order to measure the current monitor the voltage drop across the 5Ω resistor using a differential voltmeter with a sensitivity of at least 1 m/V full scale. Short out the 4.7KΩ resistor and adjust T1 until the voltage across the 5Ω resistor is within 100 microvolts of the previous reading. Re-check by alternately removing and applying the short circuit across the 4.7KΩ resistor.

Replace the 4.7KΩ resistor with a variable load. Adjust the current controls and the load until the unit delivers 2 amps at about 28 volts in the constant mode. As before, measure the current by monitoring the voltage drop across the 5Ω resistor. Because of self heating a suitable period must be allowed for the 5Ω resistor to stabilise. Short out the variable load and ensure that the voltage does not change by more than 200 microvolts.

SECTION 5

SPECIFICATION

C2

Input voltage:	105 - 240V
Output voltage:	0 - 30V d.c.
Output current:	0 - 2A

Voltage mode:

Coarse control variation:	0 - 30V
Fine control variation:	0 - 300 mV
Line stability ($\pm 7\frac{1}{2}$% mains):	0.003%
Load stability (0 to 1 max):	0.003% or 1 mV
Equivalent output resistance:	0.001 ohms
Ripple (full load):	Less than 500µV p - p
Output impedance at 1Kc/S	0.05 ohms
Typical pulse response to return to regulation band:	15µS for a 10% to 100% load change.
Temperature coefficient:	0.02% per ^{o}C.

Current mode:

Coarse control variation:	0 - 2A
Fine control variation:	0 - 25 mA
Line stability ($\pm 7\frac{1}{2}$% mains):	0.003%
Load stability (0 to V max):	0.004% or 20µA
Equivalent output resistance:	500 K ohms
Ripple (full load):	Less than 400µA p - p

Size:	8.36" x 8.71" x 8.78" (213 x 221 x 223 mm)
Weight:	11 lb. (5 Kgm)

SECTION 6

TYPICAL PERFORMANCE AND APPLICATIONS

1. Series operation voltage mode

Units may be connected in series, but diodes of current rating equal to the maximum current to be drawn must be connected across the output terminals of each unit, cathode to positive. These diodes safeguard the units against damage in overload conditions.

2. Series operation - current mode

Units connected in series will supply constant current to any load requiring a voltage higher than that which a single unit will provide. The current is controlled initially by the unit with the lowest setting. The other unit or units will operate in the constant voltage mode. As the load resistance is reduced the output voltage of this unit will tend to zero and control will then be taken over by the unit with the next highest setting.

A typical output characteristic for a series combination in constant current is shown in fig. (1). The characteristic shows a series of descending steps in output at the voltage limit points of individual units, the amplitude of the step depends on how closely the output currents have been set and it may not be possible to adjust this to better than 2 milliamps.

3. Parallel operation

Units which are set to approximately the same output voltage may be connected directly in parallel. On increasing the load the unit having the highest output voltage will carry the load until it current limits, thereafter the unit having the next highest voltage will supply the extra current until it limits and so no.

A typical output characteristic for a parallel combination of three units is shown in fig. (2). The characteristic shows a series of descending steps in output voltage at the current limitpoints of individual units. The amplitude of the step depends on how closely the output voltages have been set and it may not be possible to adjust this to better than 10 millivolts.

4. Typical performance

Stability

Output voltage and current variations are due in the main to the following causes:-

(a) Load change
(b) Mains supply change
(c) Component temperature change

(a) Load change

(i) Steady load. For a change in steady load from zero to full load, the typical output change is less than 1 millivolt at 30 volts output.

(ii) Transient response. The typical response to a pulsed load is shown in fig. (3).

(iii) Output impedance. For alternating load superimposed on a steady load the output impedance of the supply increases with frequency due to fall off in gain of the amplifier until it is determined only by the capacitor across the output terminals. A typical output impedance/frequency curve is shown in fig. (4).

(b.) Mains supply change (current and voltage modes)

Short term variations of up to ±7½% give corresponding variation of 0.003% on the output. In the voltage mode surges on the main supply in the form of short rise time pulses can be fed onto the output by stray capacity. When these conditions exist a capacitor suppressor filter should be connected in the mains lead.

(c) Component temperature change

Output variation is caused by component value changes due to temperature change The temperature change can be (i) as a result of ambient change or (ii) as a result of unit internal temperature change, caused by a change in internal dissipation from a change in load or supply to the unit.

(i) Ambient change. The typical temperature coefficient of output voltage is 0.02% per degree centigrade.

(ii) Internal change. Fig. (5) shows typical output variations caused by mains change and load change plotted against time. It must be stressed that all ventilation holes in the case must be kept free from obstruction otherwise the long term performance will seriously deteriorate.

USED ON B1975

LOCATION	COMPONENT NUMBER	QUANTITY	VALUE	TOLERANCE	MANUFACTURER	MANUFACTURER'S TYPE No.	MANUFACTURER'S RATING	OPERATIONAL RATING (MAX.)	REMARKS
CB2	R1	1	4.7KΩ	5%	WELWYN	W22			
"	R2	1	390Ω	"	WELWYN	W.22.			
CB1	R4	1	1KΩ	5%	MULLARD	MR25			
"	R5	1	1.2KΩ	"	"	TR5			
"	R6	1	470Ω	"	MULLARD	MR25			
"	R7	1	120Ω	"	"	"			
"	R8	1	3.3KΩ	"	WELWYN	4013			ALTERNATIVE TYPE C5
"	R9	1	SOT.	"	"	"			
"	R10	1	3.3KΩ	5%	ELECTROSIL	TR5			
"	R11	1	2.2KΩ	"	"	"			
"	R12	1	470Ω	"	"	"			
"	R13	1	330Ω	"	"	"			
"	R14	1	470KΩ	"	"	"			
"	R15	1	S.O.T.	"	"	"			
"	R16	1	1KΩ	"	"	"			
"	R17	1	120Ω	"	"	"			
"	R18	1	470Ω	"	"	"			
CB2	R19	1	270Ω	"	"	TR6			
CB1	R20	1	2.2KΩ	"	"	TR5			
"	R21	1	270KΩ	"	WELWYN	4013			ALTERNATIVE TYPE C5
"	R22	1	2.7KΩ	"	"	"			"
"	R23	1	100KΩ	"	ELECTROSIL	TR5			
"	R24	1	SOT	"	WELWYN	4013			ALTERNATIVE TYPE C5
"	R25	1	3.9KΩ	"	MULLARD	MR35			"
"	R26	1	1.5KΩ	"	"	4013			"
"	R27	1	470Ω	"	MULLARD	MR25			
"	R28	1	1.2KΩ	"	"	TR5			
"	R29	1	1KΩ	"	MULLARD	MR25			
HS	R30	1	68Ω	"	"	"			
CB3	R32	1	270KΩ	5%	ELECTROSIL	TR5			
CB2	R33	1	0.5Ω	"	"	"			
HS	R34	1	68Ω	"	"				
"	R35	1	10Ω	"	CGS	VPF1			
CBB1	R36	1	1.5Ω	"	WELWYN	W23			
FP	R37	1	1KΩ	"	CGS	VPF1			
HS	R38	1	68Ω	"	ELECTRSIL	C5			
"	R39	1	10Ω.	"	CGS	VPF1			
CBB1	R40	1	1.5Ω	"	WELWYN	W23			
CB3	R41	1	750Ω	"	ELECTROSIL	C5			
FP	R42	1	470Ω	"	CGS	VPF1			
CB2	C1	1	1µF		WIMA	TROPYFOL	160V		

LOCATION	COMPONENT NUMBER	QUANTITY	VALUE	TOLERANCE	MANUFACTURER	MANUFACTURER'S TYPE No.	MANUFACTURER'S RATING	OPERATIONAL RATING (MAX.)	REMARKS
BP	C2	1	2000µF		HUNTS	KB127A	50V		
"	C3	1	"		"	"	"		
CB2	C4	1	100µF		MULLARD	C437AR/H100	64V		
"	C5	1	"		"	"	"		
CB1	C6	1	100PF		WIMA	TROPYFOL	400V		
"	C7	1	0.1µF		"	"	160V		
"	C8	1	"		"	"	"		
"	C9	1	4.7µF		SIEMENS-HALSK	B32110E	63V		
CB2	C10	1	1000pF		WIMA	TROPYFOL	160V		
CB1	C11	1	100PF		"	"	"		
FP	C12	1	32µF		MULLARD	C426/AR/H32	64V		
"	C13	1	0.22µF		WIMA	TROPYFOL F.	125V		
"	C15	1	25µF		HUNTS	L575/1			
"	C16	1	1µF		WIMA	TFM	160V		
CB2	D1	1			MOTOROLA	1N4721			
"	D2	1			"	"			
"	D3	1			"	"			
"	D4	1			"	"			
"	D5	1			A.E.I.	MS4H			
"	D6	1			"	"			
CB1	D8	1			AEI	MS4H			
"	D9	1			"	"			
"	D10	1			"	"			
HS	D13	1			"	"			
CB2	Z1	1			I.R.C.	MZ10T5			
"	Z2	1			"	"			
CB1	Z3	1			MULLARD	BZY 88 C5V1			
"	Z6	1			"	" "			
"	Z7	1			HUGHES	HS2082			
"	Z8	1			"	"			
CB1	VT1	1			TEXAS	BC182			
"	VT2	1			"	2N3702			
"	VT3	1			"	BC182			
CB2	VT4	1			RCA	2N3053			
"	VT5	1			"	"			
CB1	VT6	1			TEXAS	BC182			
"	VT7	1			"	2N3702			
"	VT8	1			RCA	2N3053			
H.S.	VT9	1			"	2N3055			

	ISSUE	DATE	MOD. No.	ISSUE	DATE	MOD. No.
TRACED	5	6-3-70	751	6	4.11.71	Q1159
	4	3.3.68	406	7	5.12.72	Q 1879
CHECKED	3	1.2.68	400.	8	12.12.74	Q 3278
	2	1.12.67	390.	9	3-6-75	Q 3412
DRAWN		20.11.67				

LOCATION KEY—

SERIAL NUMBER | TESTED | DATE

FARNELL INSTRUMENTS LTD, WETHERBY, YORKS.

TITLE:— CIRCUIT DIAGRAM KEY TYPE C2.

DRAWING No. 14-3-70 B1975/K

SHEET 1 OF 2 SHEETS

USED ON B1975

LOCATION	COMPONENT NUMBER	QUANTITY	VALUE	TOLERANCE	MANUFACTURER	MANUFACTURER'S TYPE No.	MANUFACTURER'S RATING	OPERATIONAL RATING (MAX.)	REMARKS
H.S.	VT10	1			RCA	2N3055			
"	VT11	1			"	"			
CB1	T1	1	56KΩ		PLESSEY	MP			
CB3	T2	1	56KΩ		"	"			
CB3	T3	1	1KΩ		"	"			
F.P.	P1	1	25kΩ		A.B. METALS	43			
"	P2	1	250Ω		" "	"			LINEAR
"	R3	1	1kΩ		" "	"			"
"	P4	1	1kΩ		" "	"			"
									"
F.P.	M1	1			SIFAM	M34			
"	M2	1			"	"			
FP.	PL1	1			FIELD TECH. LTD	MINILAMP FT28			
"	PL2	1			" "	" "			
F.P.	SW1	1			NSF	8370/K8CHP			
"	SW2	1			"	"			
CB1	IC1.	1			PLESSEY	SL702C			
"	IC2.	1			"	"			
HS	R43	1	1KΩ	5%	ELECTROSIL	TR6			
FP	R44	1	470Ω	5%	"	"			
	F1	1	1A (A/S)		BESWICK	TDC 134			
	F2	1	2A.		"	TDC 69.			
CB2	R45	1	1KΩ	5%	ELECTROSIL	TR5			
"	R46	1	"	"	"	"			
CB1	D11	1	LINK	-	F.I.	-			
CB1	D12	1	LINK	-	F.I.	-			

LOCATION	COMPONENT NUMBER	QUANTITY	VALUE	TOLERANCE	MANUFACTURER

	ISSUE	DATE	MOD. No.	ISSUE	DATE	MOD. No.
TRACED	5	6-3-70	751	6	17.3.72	Q1344
	4	4:3:68	406.			
CHECKED	3	1:2:68	400			
	2	12.12.67	390			
DRAWN P. Pedley	1	28.11.67	—			

LOCATION KEY

SERIAL NUMBER	TESTED	DATE

FARNELL INSTRUMENTS LTD, WETHERBY, YORKS.

TITLE :— CIRCUIT DIAGRAM KEY

TYPE C2

DRAWING No. B1975/K

SHEET 2 OF 2 SHEETS

DRAWING No. B1975

THIRD ANGLE PROJECTION

TRACED	5	6·3·70	751	6	17.3.72	Q1344
	4	1·3·68	406	7	5.12.72	Q1879
CHECKED	3	26·1·68	400	8	12.12.74	Q3278
	2	12·12·67	380	9	3-6-75	Q3412
DRAWN P. Pedley	ISSUE	DATE	MOD. No.	10	30-6-75	Q3497
	1	28·11·67				

TOLERANCES

MATERIAL

PROTECTIVE FINISH

DIMENSIONS IN

FARNELL INSTRUMENTS LTD., WETHERBY, YORKS.

TITLE CIRCUIT DIAGRAM

TYPE C2

DRAWING No B1975

FARNELL INSTRUMENTS LIMITED · SANDBECK WAY · WETHERBY · YORKSHIRE LS22 4DH · TELEPHONE 0937 3541